RISK-AWARE COMMUNICATION NETWORK ARCHITECTURE AND PLANNING

Synopsis Report

DOCTOR OF PHILOSOPHY

By

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Synopsis Report

In beginning, network services were dominated by the perspective of service provider. Later on, due to the expansion of network and network services there was a shift in trend from the 'service provider view' to a 'service user view'. For the sake of user's satisfaction, this diversification revolutionized the service quality and reliability paradigm. This new paradigm brings the users in more choices and alternatives with reference to the quality and performance. In the literature, this paradigm is described as Quality of Service (QoS) framework for quality and reliability of communication services.

QoS routing is important in data transmission from the user's satisfaction. QoS routing is based on routing algorithm and path-selection. Main components of QoS can be outlined as accessibility, continuity and fulfilment of services. In the beginning, data path was selected only on the basis of shortest path routing. Therefore, real parameters like bandwidth, delay, packet loss etc. were not considered for the routing purpose. These parameters are important in deciding the performance of the data transmission. Therefore efforts have made for Quickest Path Problem (QPP) with considering other realistic parameters like reliability, energy etc. Initially, while designing the routing model for the general data transmission services, no care was made for the uncertainty associated with the network. To deal with this, reliability theory was used to deal with this situation in order to accomplish the successful services. Later on, due to the expansion in network services, network got extended with the mixture of networks components such as wired, wireless or mixed networks. In these heterogeneous networks, the environmentalist concerns attract the management in energy consumption for the network services. Several efforts were made to reduce the energy consumption and save the energy associated with network for the continuity of network services.

In the present scenario, proposed networks technology is self-sufficient to provide the critical network services. But due to the inclination of services more toward the user's perspectives, the Service Level Agreements (SLA) adopted by the network routing architecture planners for the routing models. These SLAs plays an important role in the completion of network services in different areas such as e-banking, e-business, e-healthcare etc. These SLAs are drawn with the requirement of the services. Some of the majorly used SLAs are Mean Time To Failure (MTTF), Mean Time To Repair (MTTR), up-time, availability, reliability, etc.

Although, SLAs, energy and reliabilities are considered in the design of network architecture for the critical services, but still there are chances of failure of critical services due to the catastrophic environmental conditions and manmade activities. Therefore, it is an utmost required to design backup enabled network architecture for the critical services. Different backup schemes are used in

the network routing architecture design to provide predictability, continuity and criticality in the mission critical services.

The above study motivates us to formulate the following research objectives:

1. To propose a model to analyse the impact of SLA and corresponding risk analysis for the quickest path problem in computer networks
2. To propose a model to satisfy the SLA for reliable quickest path problem in mission critical services.
3. To propose a model to satisfy the SLA and energy for reliable quickest path problem in mission critical services.
4. To propose a model for backup schemes for mission critical services using energy and service level agreements.

Objective 1: To propose a model to analyse the impact of SLA and corresponding risk analysis for the quickest path problem in computer networks

In the computer networks, role of energy and SLAs is very useful to assure the successful computation of data transmission services. In this objective, constrained approach is used to find the risk in the data transmission services and calculate the SLA violation. To analyse the impact of energy and SLAs to QPP, we have proposed a novel risk-energy aware quickest path problem (REQPP) model. The simulation results are carried out for the different values of data traffic and SLAs. The variation in these parameters shows that how these parameters are useful in the satisfaction and violation of risk-energy aware quickest path problem (REQPP).

Objective 2: To propose a model to satisfy the SLA for reliable quickest path problem in mission critical services.

In the critical services, the SLA assurance for the services is the utmost requirement and in the previous objective it only provide the measure of SLA assessment and comments on whether SLAs are satisfied or violated. It doesn't provide the SLA provisioning to the services. Therefore, in this objective SLAs are satisfied before the data transmission takes place between two specific ends. A novel model for SLAQPP has been proposed to analyse the impact of SLAs over QPP. However, while SLAQPP was proposed it was thought that network components (links) are perfect and there is no uncertainty associated with them. But later, it was realised that the failure of network components

can also play an important role in the completion of services. To deal with uncertainty, reliability theory is used to compute the reliable quickest path using SLA constraints. In addition to this, variation of SLAs is also analyzed to visualize the impact of SLAs over selection of reliable path.

Objective 3: To propose a model to satisfy the SLA and energy for reliable quickest path problem in mission critical services.

Network connectivity depends on various performance parameters, such as the reliability, capacity, and delay. The energy or power required for the transmission must be satisfied. Energy may not be always being available. If energy is unavailable, the data transmission service got disconnected which may leads to a catastrophic situation for the critical services. Here for the best explanation, we have considered the example of e-healthcare services. Therefore, the energy or power required for the e-healthcare system should be considered. In communication, energy constraints have been proposed in the form of green energy as well as other design parameters. When data related to e-healthcare is transmitted, various uncertainties in the form of natural and manmade disasters may degrade the service performance. Therefore, designing a dependable network is highly recommended. In this objective, the concept of SLAs is used to ensure performance according to the service request. In the proposed system model, energy and SLAs cooperation are considered for e-healthcare services i.e. mission critical services.

Objective 4: To propose a model for backup schemes for mission critical services using energy and service level agreements.

Although, parameters in the previous objective have been considered already to support the continuity in the data transmission, it is very difficult to maintain the continuity in the uncertain environment. This uncertainty has been caused due to many factors such as man-made activities, accidents, performance failure, congestion, delay, energy failure etc. Therefore, these factors are still major challenges in front of the network design engineers and communities. To deal with these challenges, there are several backup schemes which are used in the protection from failures. In this objective, we have proposed a constrained model for availability aware backup scheme for sustainable computing. Here disjoint path backup scheme is used for failure free sustainable computing of services.

Conclusion and future perspectives

The proposed objectives are sufficiently able to provide the risk aware network architecture for the critical applications. In future, this architecture can be made more realistic and efficient with the help of software defined network (SDN). Also, this work can be extended to the various applications of the objective such as e-shopping, e-commerce etc.

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